

Claims

What is claimed is:

1. A method of treating a batch contaminated resource comprising the steps of:

introducing at least one oxidizing agent into the batch contaminated resource; and

energizing the batch contaminated resource and the at least one oxidizing agent with an ultrasonic pressure wave.

2. The method of claim 1 wherein

the ultrasonic pressure wave for energizing the batch contaminated resource and the at least one oxidizing agent comprises at least one transducer.

3. The method of claim 1 wherein

the at least one oxidizing agent is introduced as a solution to the batch contaminated resource.

4. The method of claim 3 wherein

the solution is an aqueous solution.

5. The method of claim 3 wherein

the solution permeates the batch contaminated resource.

6. The method of claim 5 wherein

The solution flows through the batch contaminated resource.

7. The method of claim 1 further comprising

removing the at least one oxidizing agent from the batch contaminated resource after treatment.

8. The method of claim 7 wherein

the at least one oxidizing agent is introduced as a solution to the batch contaminated resource and the solution is removed after treatment.

9. The method of claim 8 wherein the solution is aqueous.

10. The method of claim 8 wherein the solution is removed using a pressure reducing device.

11. The method of claim 10 wherein the pressure reducing device is a pump.

12. The method of claim 1 wherein the at least one oxidizing agent is selected from the group consisting of: ozone, hydrogen peroxide, and combinations thereof.

13. The method of claim 2 wherein the batch contaminated resource has a boundary and wherein the step of energizing the batch contaminated resource and the at least one oxidizing agent comprises

placing the at least one transducer adjacent to the boundary of the batch contaminated resource.

14. The method of claim 2 wherein the batch contaminated resource has a boundary defining a volume and wherein the step of energizing the batch contaminated resource and the at least one oxidizing agent comprises

placing the at least one transducer within the volume of the batch contaminated resource.

15. A method to treat a batch contaminated resource comprising the step of:

arranging at least one transducer in a batch contaminated resource;

introducing at least one oxidizing agent into the batch contaminated resource; and

energizing the batch contaminated resource and the at least one oxidizing agent;

wherein the arranged at least one transducer can produce an ultrasonic pressure wave sufficient to energize the batch contaminated resource and the introduced at least one oxidizing agent.

16. The method of claim 15 wherein the step of

arranging the at least one transducer creates a uni-directional ultrasonic pressure wave.

17. The method of claim 15 wherein the step of

arranging the at least one transducer creates a multi-directional ultrasonic pressure wave.

18. The method of claim 15 wherein the step of

arranging the at least one transducer comprises producing a substantially uniform ultrasonic pressure wave in the batch contaminated resource.

19. The method of claim 15 wherein the step of

arranging the at least one transducer includes placing the at least one transducer adjacent to a boundary of the batch contaminated resource.

20. The method of claim 15 wherein the step of arranging the at least one transducer includes placing the at least one transducer within the volume of the batch contaminated resource.
21. The method of claim 15 wherein the step of introducing at least one oxidizing agent into the batch contaminated resource comprises placing an impermeable material adjacent to at least part of the batch contaminated resource boundary through which the oxidizing agent is introduced.
22. The method of claim 21 wherein the step of introducing at least one oxidizing agent into the batch contaminated resource further comprises placing a semipermeable material between the impermeable material and the at least part of the batch contaminated resource boundary.
23. An apparatus for treating a batch contaminated resource comprising:
 - at least one transducer in a transducer housing and a container having an inside and outside wherein the transducer housing is in inside the container; and
 - an energy source coupled to the at least one transducer for energizing the at least one transducer for producing ultrasonic pressure waves in the batch contaminated resource.

24. The apparatus of claim 23 wherein

the transducer housing further comprises a body having a body first open end and a body second open end;

a top adaptively coupled to the body first open end, and

a bottom adaptively coupled to the body second open end.

25. The apparatus of claim 23 wherein

At least one transducer housing is coupled a transducer shaft for varying position the at least one transducer within the container.

26. The apparatus of claim 23 wherein

the container comprises a cylinder having an open end and a cap for coupling to the open end.

27. The apparatus of claim 26 wherein

The cap includes a cap opening sufficient to allow the transducer shaft to pass; and a sealing device for producing a liquid resistant seal.

28. The apparatus of claim 27 wherein

The sealing device is a stopper can produce the liquid resistant seal between the transducer shaft and the sealing device and between the cap and the cylinder.

29. The apparatus of claim 23 further comprising

an oxidizing agent introducing device to introduce an oxidizing agent as a solution.

30. The apparatus of claim 29 wherein the

the oxidizing agent introducing device comprises an impermeable material and inlets.

31. The apparatus of claim 29 wherein
the oxidizing agent introducing device comprises an impermeable material and inlets and
a semipermeable material between at least part of a batch contaminated resource boundary and the impermeable material.
32. The apparatus of claim 29 further comprising
a pressure reducing device to remove the solution after treatment.
33. The apparatus of claim 32 wherein
the pressure reducing device is a pump.
34. A method of treating a batch contaminated resource comprising the steps of:
adding at least one binding agent to the batch contaminated resource;
introducing at least one oxidizing agent into the added batch contaminated resource; and
energizing the added batch contaminated resource and the at least one oxidizing agent with an ultrasonic pressure wave.
35. The method of claim 34 wherein
the ultrasonic pressure wave for energizing the added batch contaminated resource and the at least one oxidizing agent comprises at least one transducer.
36. The method of claim 34 wherein
the at least one oxidizing agent is introduced as a solution to the added batch contaminated resource.
37. The method of claim 36 wherein

the solution is an aqueous solution.

38. The method of claim 36 wherein
the solution permeates the added batch contaminated resource.

39. The method of claim 38 wherein
The solution flows through the added batch contaminated resource.

40. The method of claim 34 further comprising
removing the at least one oxidizing agent from the added batch contaminated resource after treatment.

41. The method of claim 40 wherein
the at least one oxidizing agent is introduced as a solution to the added batch contaminated resource and the solution is removed after treatment.

42. The method of claim 41 wherein the solution is aqueous.

43. The method of claim 41 wherein the solution is removed using a pressure reducing device.

44. The method of claim 43 wherein the pressure reducing device is a pump.

45. The method of claim 34 wherein the at least one oxidizing agent is selected from the group consisting of: ozone, hydrogen peroxide, and combinations thereof.

46. The method of claim 35 wherein the added batch contaminated resource has a boundary and wherein the step of energizing the added batch contaminated resource and the at least one oxidizing agent comprises
placing the at least one transducer adjacent to the boundary of the added batch contaminated resource.

47. The method of claim 35 wherein the added batch contaminated resource has a boundary defining a volume and wherein the step of energizing the added batch contaminated resource and the at least one oxidizing agent comprises

placing the at least one transducer within the volume of the added batch contaminated resource.

48. A method to treat a batch contaminated resource comprising the step of:

adding at least one binding agent to a batch contaminated resource;

arranging at least one transducer in the added batch contaminated resource;

introducing at least one oxidizing agent into the added batch contaminated resource; and

energizing the added batch contaminated resource and the at least one oxidizing agent;

wherein the arranged at least one transducer can produce an ultrasonic pressure wave sufficient to energize the added batch contaminated resource and the introduced at least one oxidizing agent.

49. The method of claim 48 wherein the step of

arranging the at least one transducer creates a uni-directional ultrasonic pressure wave.

50. The method of claim 48 wherein the step of

arranging the at least one transducer creates a multi-directional ultrasonic pressure wave.

51. The method of claim 48 wherein the step of

arranging the at least one transducer comprises producing a substantially uniform ultrasonic pressure wave in the added batch contaminated resource.

52. The method of claim 48 wherein the step of
arranging the at least one transducer includes placing the at least one
transducer adjacent to a boundary of the added batch contaminated resource.

53. The method of claim 48 wherein the step of
arranging the at least one transducer includes placing the at least one
transducer within the volume of the added batch contaminated resource.

54. The method of claim 48 wherein the step of
introducing at least one oxidizing agent into the added batch
contaminated resource comprises placing an impermeable material adjacent to at
least part of the added batch contaminated resource boundary through which the
oxidizing agent is introduced.

55. The method of claim 54 wherein the step of
introducing at least one oxidizing agent into the added batch
contaminated resource further comprises placing a semipermeable material
between the impermeable material and the at least part of the added batch
contaminated resource boundary.